

# High-Frequency, Low-Noise Nitride-Based Power Transistors Grown on Bulk III-N, Phase I

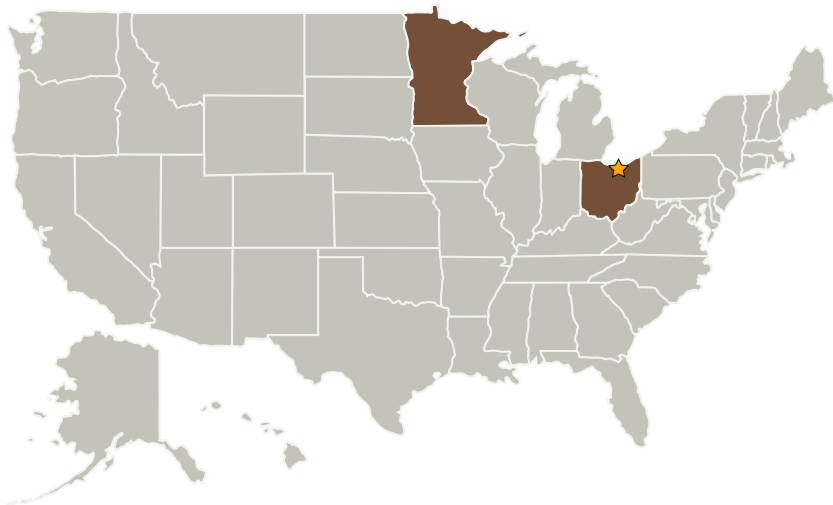
Completed Technology Project (2003 - 2003)



## Project Introduction

One of the main issues for III-nitride growth is the lack of a suitable native substrate. Growth on foreign substrates such as sapphire or SiC results in nitride material with a high density of defects due to large mismatches in lattice constant and thermal expansion. Nonetheless, nitride devices grown on these substrates have demonstrated optical and electronic properties that are practically unmatched by other material systems. In particular, the AlGaIn/GaN high electron mobility transistors (HEMTs) constitute a leading candidate for simultaneously realizing ultrahigh-frequency low-noise amplifiers and power amplifiers. Here, we propose to use high quality bulk GaN and AlN substrates for substantial improvements in the operation of AlGaIn/GaN HEMTs. We also propose a method of isolating the n-type substrate from the active layer. In this way, we take advantage of the reduced thermal and lattice mismatch, lower density of threading dislocations, and improved thermal conductance to significantly improve the dc and RF operation of these devices. Some projected HEMT device parameters to achieve are a current density  $> 1.5 \text{ A/mm}$ , extrinsic transconductance values  $> 400 \text{ mS/mm}$ ,  $f_{\text{max}} > 200 \text{ GHz}$ , and power density  $> 10 \text{ W/mm}$  at  $40 \text{ GHz}$ .

## Primary U.S. Work Locations and Key Partners



High-Frequency, Low-Noise  
Nitride-Based Power Transistors  
Grown on Bulk III-N, Phase I

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## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

### Lead Center / Facility:

Glenn Research Center (GRC)

### Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
★ Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
SVT Associates	Supporting Organization	Industry	Eden Prairie, Minnesota

Primary U.S. Work Locations	
Minnesota	Ohio

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

Carlos Torrez

**Project Manager:**

Jon C Freeman

**Principal Investigator:**

Amir Dabiran

## Technology Areas

**Primary:**

- TX05 Communications, Navigation, and Orbital Debris Tracking and Characterization Systems
  - └ TX05.2 Radio Frequency
    - └ TX05.2.2 Power-Efficiency